



Business Applications

Hybrid Cloud Solutions

NetApp
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NetApp Cloud Volumes Service For AWS

A review of Oracle performance as it pertains to the NetApp Cloud Volumes Service in AWS.

Authors: Ali Aiello, Joe Carter, Chad Morgenstern

If you are thinking about your data in the clouds, consider that the NetApp Cloud Volumes Service is about more than just NFS or SMB. With the NetApp Cloud Volumes Service, you can rest assured that your data is durable, encrypted, highly available and performant.

Please see the blog [NetApp Cloud Volumes, Not Your Mothers File Service](#) for details regarding how NetApp Cloud Volumes approaches durability, encryption, and availability as well as some really nice details regarding the Cloud Volumes snapshot technology.

The remainder of blog focuses on Oracle performance. Oracle is especially well suited for inclusion in the NetApp Cloud Volumes Service. Beyond the fact that your data is protected by 8 nines of durability and is accessible across all the availability zones within a given region, Oracle's Direct NFS client seems almost purpose built for Amazon's AWS architecture. More on that later.

Performance

When performing evaluations of database workloads, always keep in mind the impact of server memory. Ideally queries find their data resident therein as latency from memory is always going to be orders of magnitude lower than any "disk" query. What does this mean for you? While storage latency matters, memory hit percentage matters more. When database administrators say that they need a latency of X, keep in mind what they are talking about.

With that said...

The Oracle Direct NFS client spawns many network sessions to each NetApp Cloud volume, doing so as load demands. The vast number of network sessions brings the potential for a significant amount of throughput for the database. Far greater than a single network session can provide in AWS.

To test Oracle's ability to generate load, NetApp ran a series of proofs of concept across various EC2 instance types, with various workload mixtures and volume counts. The SLOB2 workload generator drove the workload against a single Oracle 12.2c database. Keep in mind that at present AWS has no support for Oracle RAC, so single node testing was our only option.

The testing showed that the while any instance size is fine - run an instance size according to your need - Oracle and NetApp Cloud Volumes can consume the resources of even the largest instance. Towards that end, the graphics below focus on the c5.18xlarge instance type.

Workload : 100% Update

Amazon AWS imposes an architectural egress limit of 5Gbps for all I/O leaving the VPC. This limit defines the lower threshold in the graphic below, as seen in the 100% update workload represented by the green lines

below. This workload amounts to 50% read and 50% write, the writes being the limiting factor. Though the two-volume test resulted in slightly lower application latency compared to the one-volume test, both volume counts converge at the same point the VPC egress limit which worked out to be just around 130,000 Oracle IOPS.

Workload : 100% Read

The 100% read workload represents the upper limit for the Oracle Database running against the NetApp Cloud Volumes Service in AWS. The pure read workload scenario, as shown by the red lines, is limited only by the instance type and the amount of network and CPU resources available to the instance. Just as the 100% update workload discussed above, though the two-volume configuration resulted in lower application latency, the tested configurations converged at the instance resource limit. In this case just shy of 300,000 Oracle IOPS.

Workload : 75% Read 25% Update

The third workload, shown in purple, is a 75% Oracle read and 25% Oracle update or read-modify-write workload. This scenario performed exceptionally well be it with one or two volumes, though the two-volume scenario outperformed the other. Many database administrators prefer the simplicity of a single volume database, 200,000 IOPS ought to satisfy all but the most demanding of database needs and doing so with the simple layout desired by these dba's. For those needing more, additional volumes will enable greater throughput as shown below.

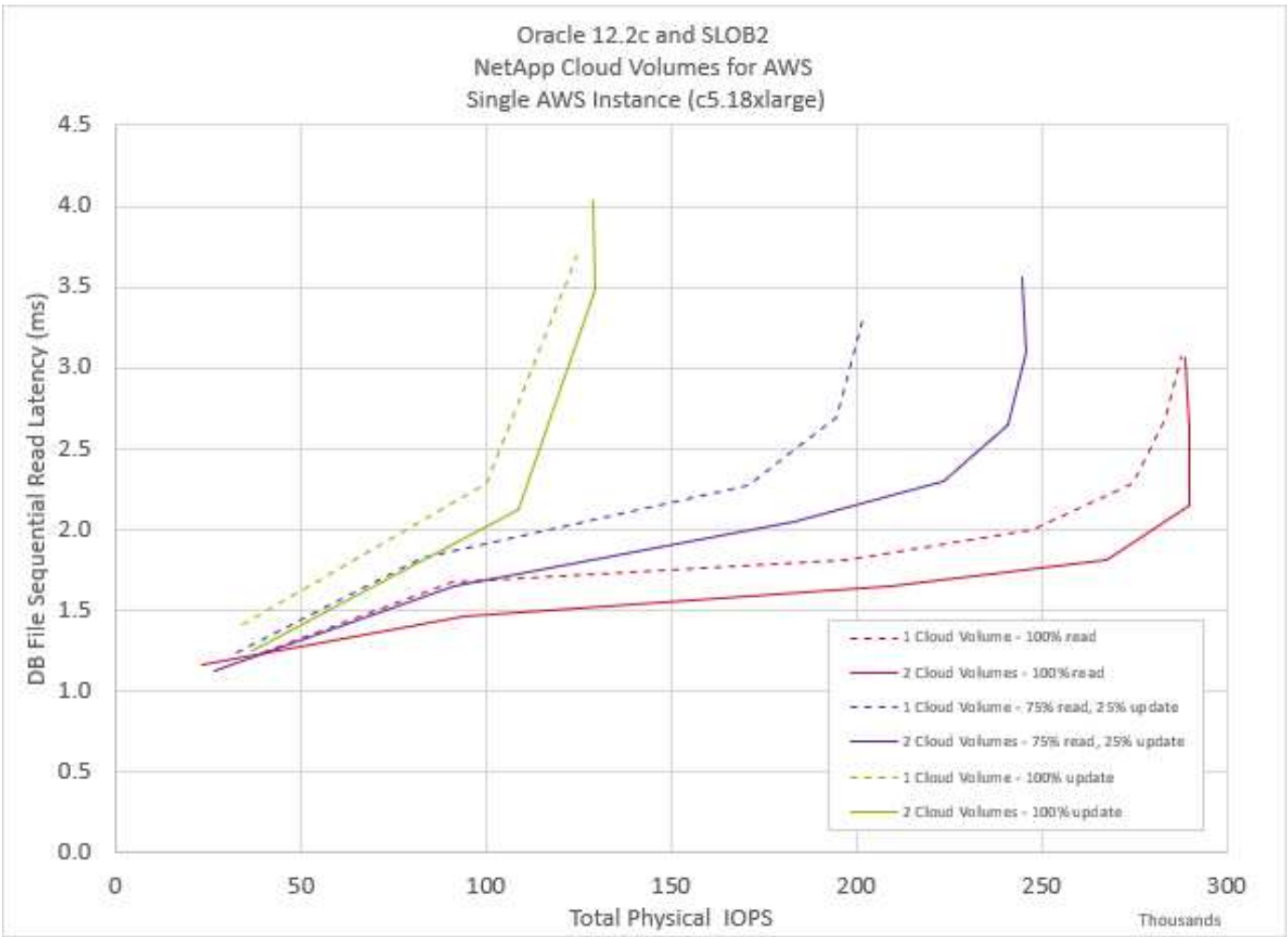


Figure 1. Oracle SLOB Test Graphic

Best Practices

- init.ora file
 - db_file_multiblock_read_countr
 - remove this option if present
- Redo block size:
 - Set to either 512 or 4KB, in general leave as default 512, unless recommended otherwise by App or Oracle.
 - If redo rates are greater than 50MBps, consider testing a 4KB block size
- Network considerations
 - Enable TCP timestamps, selective acknowledgement (SACK), and TCP window scaling on hosts
- Slot tables
 - sunrpc.tcp_slot_table_entries = 128
 - sunrpc.tcp_max_slot_table_entries = 65536
- Mount options

File Type	Mount Options
ADR_home	rw,bg,hard,vers=3,proto=tcp,timeo=600,rsize=65536,wsiz=65536
Oracle Home	rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=65536,wsiz=65536,nointr
Control Files	rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=65536,wsiz=65536,nointr
Redo Logs	rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=65536,wsiz=65536,nointr
Datafiles	rw,bg,hard,vers=3,proto=tcp,timeo=600,rsiz=65536,wsiz=65536,nointr

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of data across cloud and on-premises environments to accelerate digital transformation. NetApp empowers global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize operations. For more information, visit: www.netapp.com #DataDriven

Technical Reports

MySQL

Blogs

MySQL in the Clouds

A review of MySQL performance as it pertains to the NetApp Cloud Volumes Service in AWS.

Authors: Ali Aiello, Chad Morgenstern, Ron Pratt

Are looking for consistently good performance for your MySQL database - I mean, really, who is going to answer no to that question? With or without snapshots, whether you are accessing the primary database or a snapshotted copy, you can expect excellent, consistent performance from the NetApp Cloud Volumes Service. Performance is of course not the whole story. Databases need durability, data is a crown jewel of any enterprise. Consumers demand the protection against theft provided by encryption, we've got that too, its managed by the service. Add to these the advantage of accessing database volumes from any availability zone within the region – without the need to replicate to make this possible – and you'll find that the NetApp Cloud Volumes Service is the ideal solution for your MySQL needs.

Please see the blog [NetApp Cloud Volumes, Not Your Mothers File Service](#) for details regarding how NetApp Cloud Volumes approaches durability, encryption, and availability as well as some really nice details regarding the Cloud Volumes snapshot technology.

The remainder of this blog focuses on MySQL performance.

Performance

When performing evaluations of database workloads, always keep in mind the impact of server memory. Ideally queries find their data resident therein as latency from memory is always going to be orders of magnitude lower than any “disk” query. What does this mean for you? While storage latency matters, memory hit percentage matters more. When database administrators say that they need a latency of X, keep in mind what they are talking about.

With that said...

The Workload Generator

To test MySQL with cloud volumes, NetApp used the TPC Benchmark C workload generator. TPCC is an industry standard online transaction processing (OLTP) benchmark that leverages actual MySQL databases and their I/O paths. Workload generators that leverage real applications are always preferred over more synthetic generators such as Vdbench, Iozone, and heaven forbid dd, tar, cpio, or cp. TPCC standardized on an 80/20 read:write workload, the test results in this section are based there on.

The Scenarios

Two scenarios were tested in this environment, the first evaluated the capabilities of a single instance to drive MySQL I/O, while the second set out to determine the edges of a single cloud volume. The results of both scenarios are shown in the graphic below. The gray line represents the single-instance and blue the multi-instance environment. Please note that the latency reported in the graphics below represent storage latency as reported by the database.

The Results

Run against the single instance, TPCC generated approximately 4.5Gbps worth of I/O which approaches the Amazon Web Service inter-VPC limit imposed per network connection. Run against multiple instances, TPCC generated just about 16Gbps of throughput against a single Cloud Volume - which is pretty darned cool.

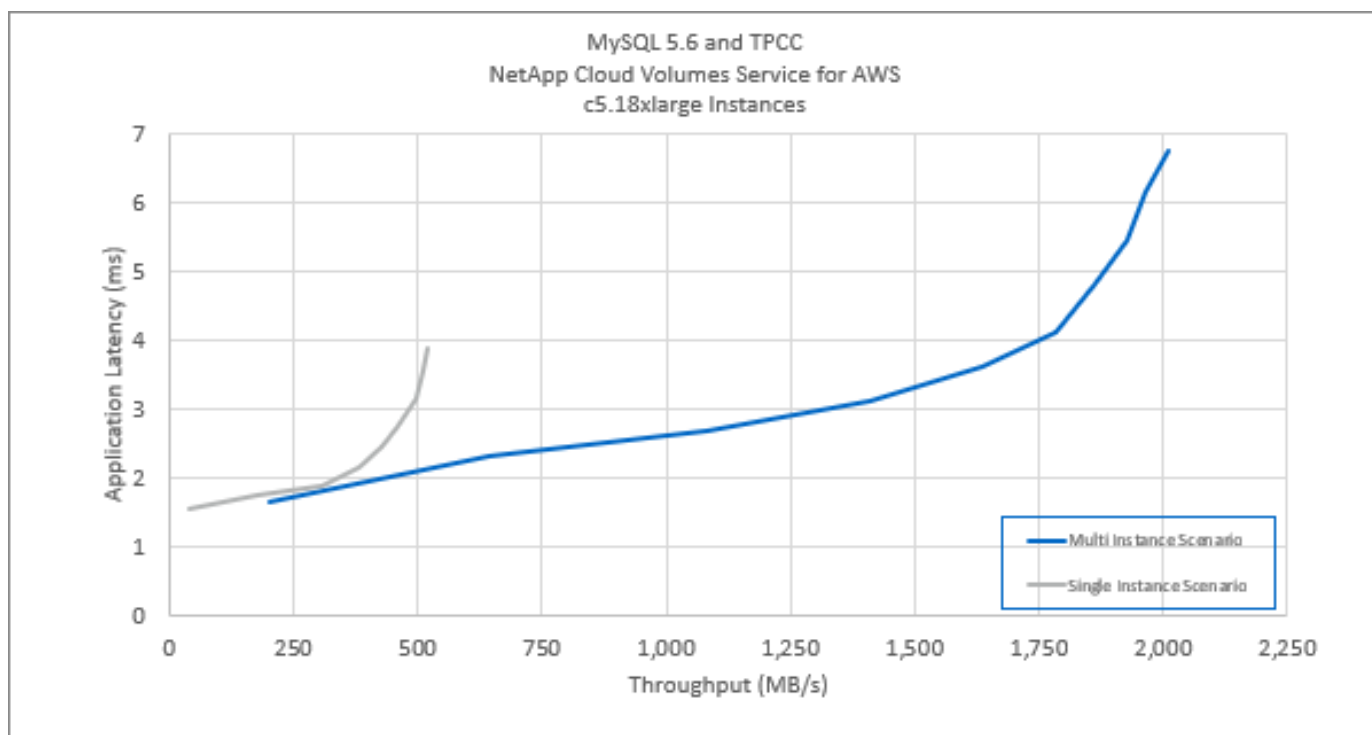


Figure 2. MySQL TPCC Test Graphic

Best Practices

The following parameters were placed in the MySQL `/etc/my.cnf` configuration file.

- [MySQLd]
 - `innodb_buffer_pool_size=23622320128`
 - `innodb_log_buffer_size=4294967295`
 - `innodb_log_file_size=1073741824`
 - `innodb_flush_log_at_trx_commit=2`
 - `innodb_open_files=4096`
 - `innodb_page_size=4096`
 - `innodb_read_io_threads=64`
 - `innodb_write_io_threads=64`
 - `performance_schema`
 - `innodb_doublewrite=0;`
 - `max_connections=1000`
 - `innodb_thread_concurrency=128`
 - `innodb_max_dirty_pages_pct=0`

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